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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/994,397	11/26/2001	Paul R. Besser	039153-0472 (G1177)	7858

7590 03/10/2004

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EXAMINER	
GUERRERO, MARIA F	

ART UNIT	PAPER NUMBER
2822	

DATE MAILED: 03/10/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/994,397	BESSER ET AL.	
	Examiner	Art Unit	
	Maria Guerrero	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 January 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *8-25-03; 11-3-03*.
4) ☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. *20040301* .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. This Office Action is in response to the amendment and the request for continued examination filed January 7, 2004.

Claims 1-20 are pending.

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on January 7, 2004 has been entered.

Claim Objections

3. Claim 18 is objected to because of the following informalities: claim recites the dose being 2 e14 to 2 e15/cm2; it is suggested to specify the dose as atom/cm2 or ions/cm2. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Andricacos et al. (U.S. 6,268,291) in view of Farrar (U.S. 6,426,289) and Liu et al. (U.S. 6,015,749) (cited by Applicant).

Andricacos et al. teaches forming a barrier material layer along lateral sidewalls and a bottom of a via, the via electrically connecting a first conductive layer and a second conductive layer (Fig. 2, 4B, 5B, 6, col. 8, lines 48-60, col. 10, lines 13-20, 35-40). Andricacos et al. discloses implanting a metal into the barrier material layer, the implanted metal making the barrier material layer more resistant to copper diffusion (col. 5, lines 60-65, col. 6, lines 45-67, col. 8, lines 15-20, col. 10, lines 33-40, 48-55, 60-65). Andricacos et al. shows the barrier layer being tantalum and implanting tin (Sn) (heavy metal) (col. 10, lines 52-55, 62-65).

In addition, Andricacos et al. shows the implanted metal forms an intermetallic with the second conductive layer (copper) (col. 13, lines 5-10). Andricacos et al. teaches providing a copper layer over an integrated circuit substrate, providing a barrier material layer at a bottom and sides of a via positioned over the copper layer, implanting a low dose metal species into the barrier material layer (Fig. 2, 4b, 6, col. 8, lines 48-65).

Furthermore, Andricacos et al. discloses depositing a copper layer, depositing an etch stop layer over the copper layer, and depositing an insulating layer over the etch stop layer (Fig. 2, col. 8, lines 30-55). Andricacos et al. teaches forming an aperture in the insulating layer and the etch stop layer, providing a barrier material at a bottom and sides of the aperture, implanting a metal species into the barrier material layer (sidewalls of the via), the implanted metal making the barrier material layer more resistant to copper diffusion (Fig.2, 4B, 6, col. 10, lines 15-20, 35-40, and 48-50). Andricacos et al. inherently shows that the implanting make the barrier material layer amorphous. Andricacos et al. shows filling the aperture with a via material to form a via and providing a conductive layer over the via such that the via electrically connects the conductive layer to the copper layer (Fig. 2, 6, col. 8, lines 35-60).

Andricacos et al. does not specifically show the specific thickness, energy, tilted angle, and dose as claimed. However, Andricacos et al. teaches implanting at various energies ranging from a few KeV to several hundred KeV (col. 11, lines 7-10). Andricacos et al. also discloses that during the implantation the wafer can be rotated to achieve uniformity and the energy and dose can be adjusted (col. 4, lines 17-37). In addition, Farrar shows forming a barrier layer having a thickness of 5 to 40 Angstroms and implanting with an energy level between 0.125 KeV to 2.0 KeV (col. 4, lines 25-38).

Liu et al. teaches implanting with an implanted tilted angle (0 to 20 degrees) to prevent implant damage (col. 2, lines 38-41, col. 4, lines 15-25). Liu et al. shows a dose of about 1e15 atoms/cm2 (col. 4, lines 20-21).

Furthermore, "where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Andricacos et al. reference by including the thickness and energy taught by Farrar and the tilted angle and energy taught by Liu et al. in order to better control the implantation process and to prevent damage (Liu et al., col. 2, lines 38-41). The modification is proper because the claimed ranges are not critical to the invention.

Furthermore, to establish unexpected results over a claimed range, applicants should compare a sufficient number of tests both inside and outside the claimed range to show the criticality of the claimed range. In re Hill, 284 F.2d 955, 128 USPQ 197 (CCPA 1960). The applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990).

Response to Arguments

5. Applicant's arguments with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Blish, II et al. (U.S. 5,882,738) (of record) is cited as evidenced to show that Andricacos et al. inherently shows that the implanting make the barrier

material layer amorphous. Lopatin et al. (US 2004/0023486 A1) teach several steps pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maria Guerrero whose telephone number is 571-272-1837.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 571-272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Maria Guerrero
Primary Examiner
March 3, 2004